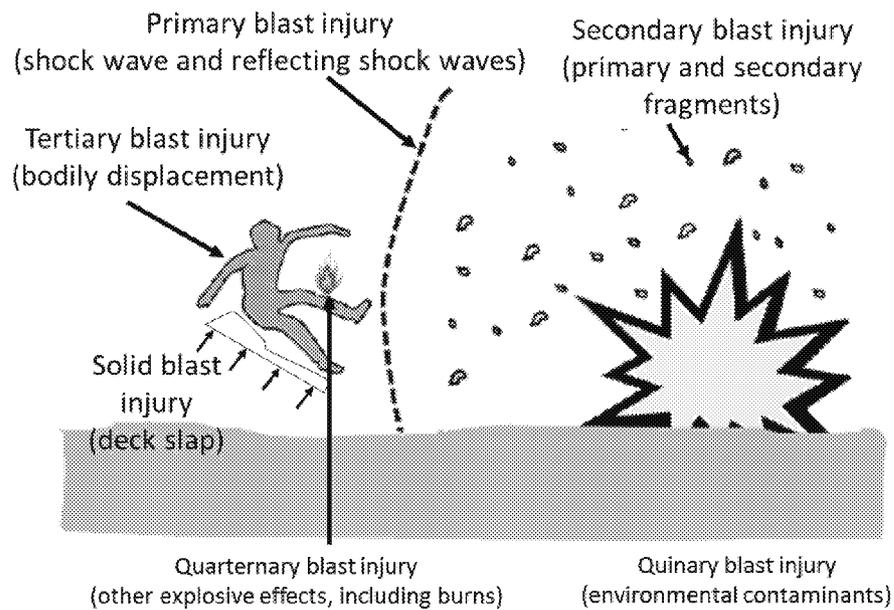


## 2 **Classification of Blast Injuries (Hepper, Clasper, Mahoney, Bull, Ballard)**

2.1 Blast injuries fall into five main categories [Zuckerman *et al.*, 1941; Maynard *et al.*, 1989; US DoDD 6025.21E, 2006; Stuhmiller, 2008]: Primary, Secondary, Tertiary, Quaternary and Quinary injury. There is a high degree of agreement between different authors for the definition of Primary, Secondary, Tertiary and Quaternary injury. This is not the case for the most recent definition, Quinary injury. These are shown schematically in Figure 3.



**Figure 3.** Blast injury modalities

2.2 *Primary* blast injuries result from the interaction of a shock wave with the body. Injury is largely confined to the air-containing organs, such as the lungs, airway and bowel, often without external signs of injury [Clemedson, 1956].

2.2.1 One commonly cited example of a primary blast injury is *blast lung* where there has been bleeding into the tissue of the lung itself with possible damage to the lung structure resulting in air leak. Another is *blast bowel* where bleeding occurs from the intestinal wall. These injuries are caused by the shock wave entering the body resulting in *stress waves*. These stress waves may be *shear waves* (forces at right angles to the direction of travel of the shock wave) at the air/body interfaces, rupturing the surface membranes, or may be *compaction waves* (forces in the direction of the motion of the shock wave) causing material damage through tension and compression.